

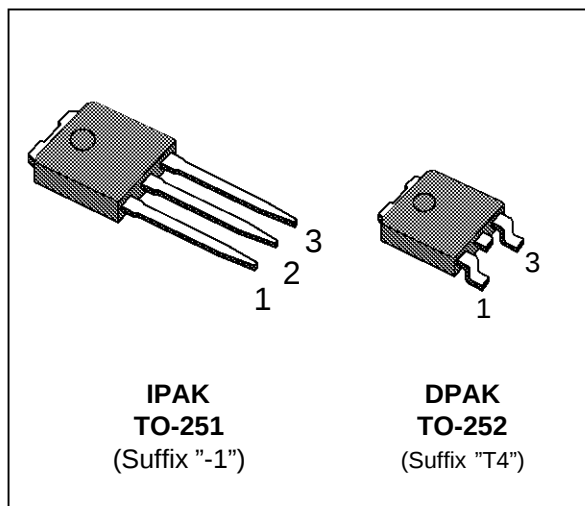
## N - CHANNEL ENHANCEMENT MODE POWER MOS TRANSISTOR

| TYPE    | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|---------|------------------|---------------------|----------------|
| STD6N10 | 100 V            | < 0.45 $\Omega$     | 6 A            |

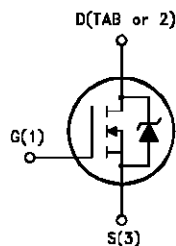
- TYPICAL R<sub>DS(on)</sub> = 0.35  $\Omega$
- AVALANCHE RUGGED TECHNOLOGY
- 100% AVALANCHE TESTED
- REPETITIVE AVALANCHE DATA AT 100°C
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- 175°C OPERATING TEMPERATURE
- APPLICATION ORIENTED CHARACTERIZATION
- THROUGH-HOLE IPAK (TO-251) POWER PACKAGE IN TUBE (SUFFIX "-1")
- SURFACE-MOUNTING DPAK (TO-252) POWER PACKAGE IN TAPE & REEL (SUFFIX "T4")

### APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SOLENOID AND RELAY DRIVERS
- REGULATORS
- DC-DC & DC-AC CONVERTERS
- MOTOR CONTROL, AUDIO AMPLIFIERS
- AUTOMOTIVE ENVIRONMENT (INJECTION, ABS, AIR-BAG, LAMPDRIVERS, Etc.)



### INTERNAL SCHEMATIC DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                              | Value      | Unit |
|---------------------|--------------------------------------------------------|------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)             | 100        | V    |
| V <sub>DGR</sub>    | Drain- gate Voltage (R <sub>GS</sub> = 20 k $\Omega$ ) | 100        | V    |
| V <sub>GS</sub>     | Gate-source Voltage                                    | $\pm 20$   | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 25 °C   | 6          | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 100 °C  | 4          | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                                 | 24         | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C            | 35         | W    |
|                     | Derating Factor                                        | 0.23       | W/°C |
| T <sub>stg</sub>    | Storage Temperature                                    | -65 to 175 | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                    | 175        | °C   |

(•) Pulse width limited by safe operating area

## THERMAL DATA

|                |                                                |     |      |                      |
|----------------|------------------------------------------------|-----|------|----------------------|
| $R_{thj-case}$ | Thermal Resistance Junction-case               | Max | 4.29 | $^{\circ}\text{C/W}$ |
| $R_{thj-amb}$  | Thermal Resistance Junction-ambient            | Max | 100  | $^{\circ}\text{C/W}$ |
| $R_{thc-sink}$ | Thermal Resistance Case-sink                   | Typ | 1.5  | $^{\circ}\text{C/W}$ |
| $T_l$          | Maximum Lead Temperature For Soldering Purpose |     | 275  | $^{\circ}\text{C}$   |

## AVALANCHE CHARACTERISTICS

| Symbol   | Parameter                                                                                                                          | Max Value | Unit |
|----------|------------------------------------------------------------------------------------------------------------------------------------|-----------|------|
| $I_{AR}$ | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by $T_j$ max, $\delta < 1\%$ )                                | 6         | A    |
| $E_{AS}$ | Single Pulse Avalanche Energy (starting $T_j = 25^{\circ}\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 25\text{ V}$ )                     | 20        | mJ   |
| $E_{AR}$ | Repetitive Avalanche Energy (pulse width limited by $T_j$ max, $\delta < 1\%$ )                                                    | 5         | mJ   |
| $I_{AR}$ | Avalanche Current, Repetitive or Not-Repetitive ( $T_c = 100^{\circ}\text{C}$ , pulse width limited by $T_j$ max, $\delta < 1\%$ ) | 4         | A    |

ELECTRICAL CHARACTERISTICS ( $T_{case} = 25^{\circ}\text{C}$  unless otherwise specified)

## OFF

| Symbol        | Parameter                                        | Test Conditions                                                                                     | Min. | Typ. | Max.      | Unit                           |
|---------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------------|------|------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown Voltage                   | $I_D = 250\text{ }\mu\text{A}$ $V_{GS} = 0$                                                         | 100  |      |           | V                              |
| $I_{DSS}$     | Zero Gate Voltage Drain Current ( $V_{GS} = 0$ ) | $V_{DS} = \text{Max Rating}$<br>$V_{DS} = \text{Max Rating} \times 0.8$ $T_c = 125^{\circ}\text{C}$ |      |      | 1<br>10   | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GSS}$     | Gate-body Leakage Current ( $V_{DS} = 0$ )       | $V_{GS} = \pm 20\text{ V}$                                                                          |      |      | $\pm 100$ | nA                             |

## ON (\*)

| Symbol       | Parameter                         | Test Conditions                                                     | Min. | Typ. | Max. | Unit     |
|--------------|-----------------------------------|---------------------------------------------------------------------|------|------|------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage            | $V_{DS} = V_{GS}$ $I_D = 250\text{ }\mu\text{A}$                    | 2    | 3    | 4    | V        |
| $R_{DS(on)}$ | Static Drain-source On Resistance | $V_{GS} = 10\text{ V}$ $I_D = 3\text{ A}$                           |      | 0.35 | 0.45 | $\Omega$ |
| $I_{D(on)}$  | On State Drain Current            | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$<br>$V_{GS} = 10\text{ V}$ | 6    |      |      | A        |

## DYNAMIC

| Symbol       | Parameter                    | Test Conditions                                              | Min. | Typ. | Max. | Unit |
|--------------|------------------------------|--------------------------------------------------------------|------|------|------|------|
| $g_{fs} (*)$ | Forward Transconductance     | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 3\text{ A}$ | 1.2  | 3    |      | S    |
| $C_{iss}$    | Input Capacitance            | $V_{DS} = 25\text{ V}$ $f = 1\text{ MHz}$ $V_{GS} = 0$       |      | 265  | 400  | pF   |
| $C_{oss}$    | Output Capacitance           |                                                              |      | 65   | 90   | pF   |
| $C_{rss}$    | Reverse Transfer Capacitance |                                                              |      | 20   | 30   | pF   |

**ELECTRICAL CHARACTERISTICS** (continued)**SWITCHING ON**

| Symbol                        | Parameter                                                    | Test Conditions                                                                                                        | Min. | Typ.         | Max.     | Unit           |
|-------------------------------|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------|--------------|----------|----------------|
| $t_{d(on)}$<br>$t_r$          | Turn-on Time<br>Rise Time                                    | $V_{DD} = 50\text{ V}$ $I_D = 3\text{ A}$<br>$R_G = 50\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 3) |      | 10<br>40     | 15<br>60 | ns<br>ns       |
| $(di/dt)_{on}$                | Turn-on Current Slope                                        | $V_{DD} = 80\text{ V}$ $I_D = 6\text{ A}$<br>$R_G = 50\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 5) |      | 280          |          | A/ $\mu$ s     |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge | $V_{DD} = 80\text{ V}$ $I_D = 6\text{ A}$ $V_{GS} = 10\text{ V}$                                                       |      | 13<br>6<br>4 | 20       | nC<br>nC<br>nC |

**SWITCHING OFF**

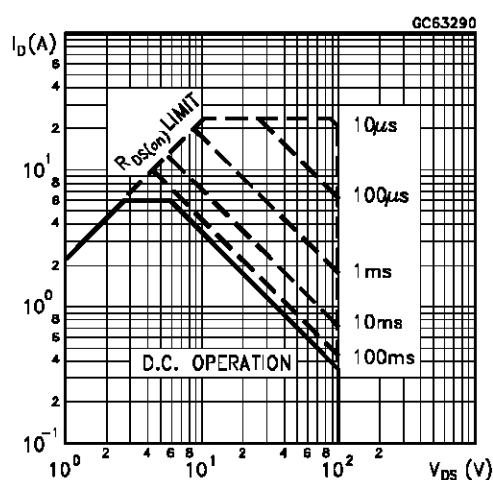
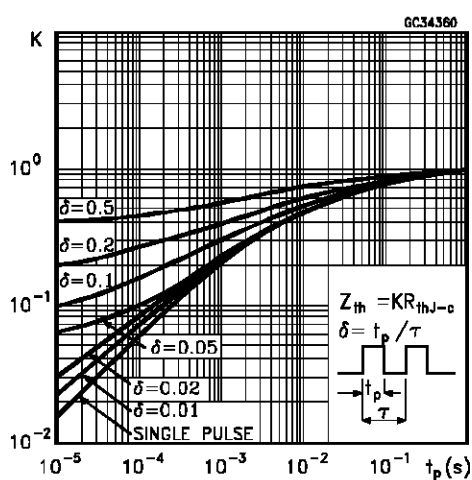
| Symbol                          | Parameter                                             | Test Conditions                                                                                                        | Min. | Typ.           | Max.           | Unit           |
|---------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------|----------------|----------------|----------------|
| $t_{r(Voff)}$<br>$t_f$<br>$t_c$ | Off-voltage Rise Time<br>Fall Time<br>Cross-over Time | $V_{DD} = 80\text{ V}$ $I_D = 6\text{ A}$<br>$R_G = 50\ \Omega$ $V_{GS} = 10\text{ V}$<br>(see test circuit, figure 5) |      | 15<br>20<br>35 | 25<br>30<br>55 | ns<br>ns<br>ns |

**SOURCE DRAIN DIODE**

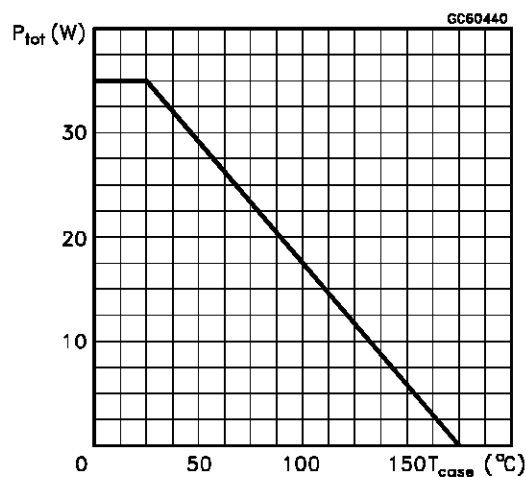
| Symbol                            | Parameter                                                                             | Test Conditions                                                                                                                                      | Min. | Typ.            | Max.    | Unit                     |
|-----------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------|---------|--------------------------|
| $I_{SD}$<br>$I_{SDM}(\bullet)$    | Source-drain Current<br>Source-drain Current<br>(pulsed)                              |                                                                                                                                                      |      |                 | 6<br>24 | A<br>A                   |
| $V_{SD} (*)$                      | Forward On Voltage                                                                    | $I_{SD} = 6\text{ A}$ $V_{GS} = 0$                                                                                                                   |      |                 | 1.5     | V                        |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse Recovery<br>Time<br>Reverse Recovery<br>Charge<br>Reverse Recovery<br>Current | $I_{SD} = 6\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$<br>$V_{DD} = 30\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$<br>(see test circuit, figure 5) |      | 85<br>0.25<br>6 |         | ns<br>$\mu\text{C}$<br>A |

(\*) Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %

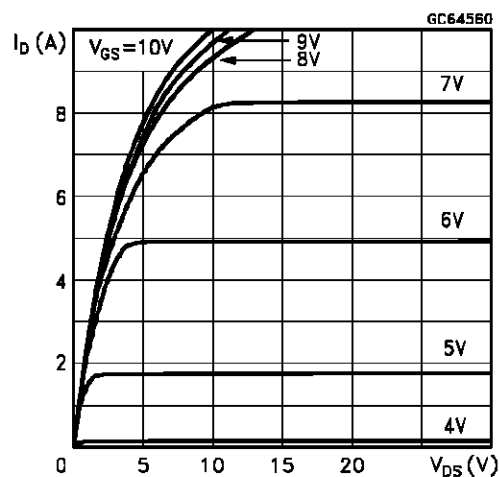
(\bullet) Pulse width limited by safe operating area

**Safe Operating Area****Thermal Impedance**

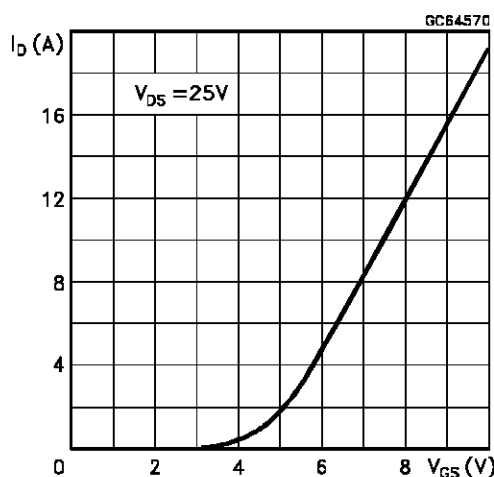
## Derating Curve



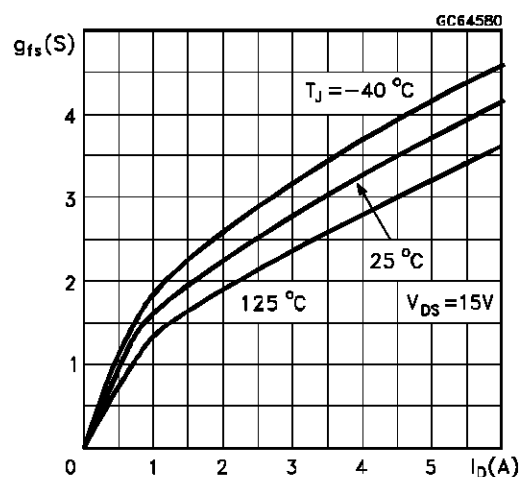
## Output Characteristics



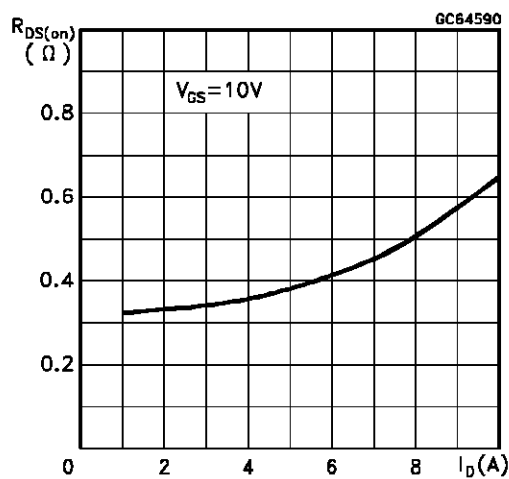
## Transfer Characteristics



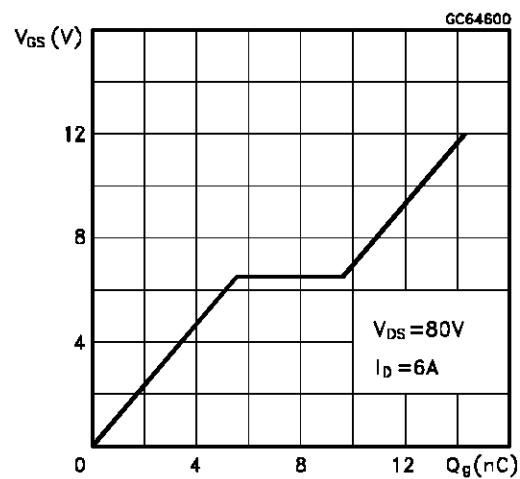
## Transconductance



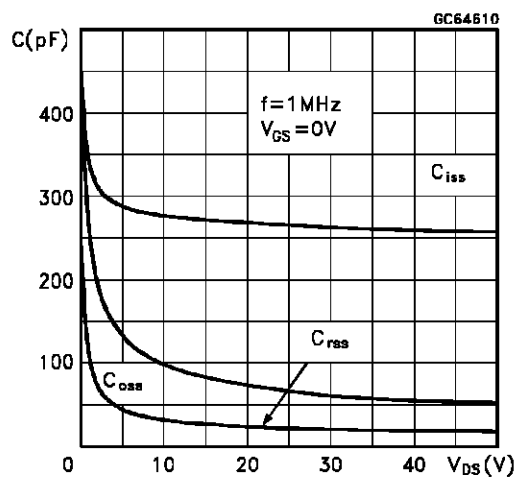
## Static Drain-source On Resistance



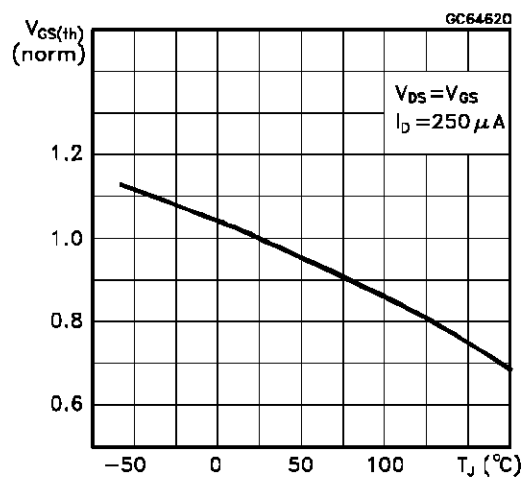
## Gate Charge vs Gate-source Voltage



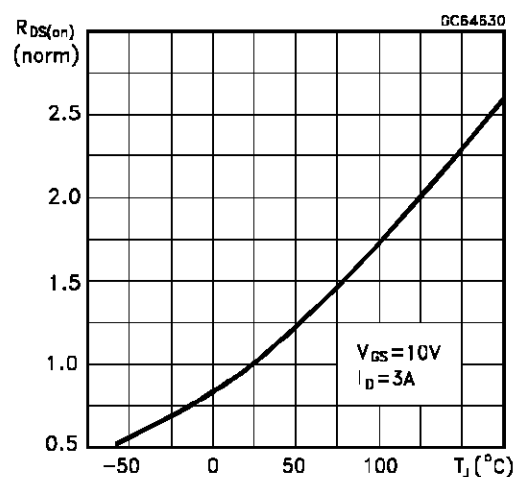
## Capacitance Variations



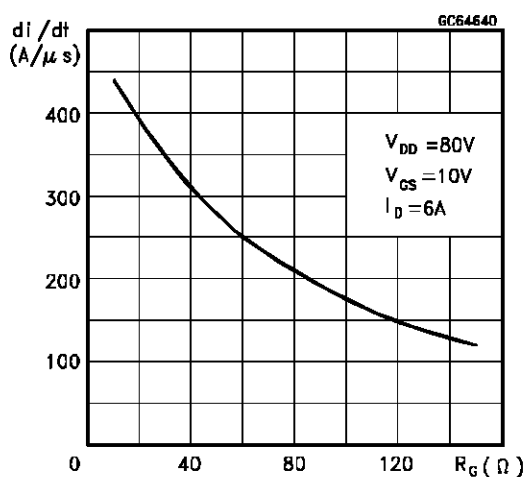
## Normalized Gate Threshold Voltage vs Temperature



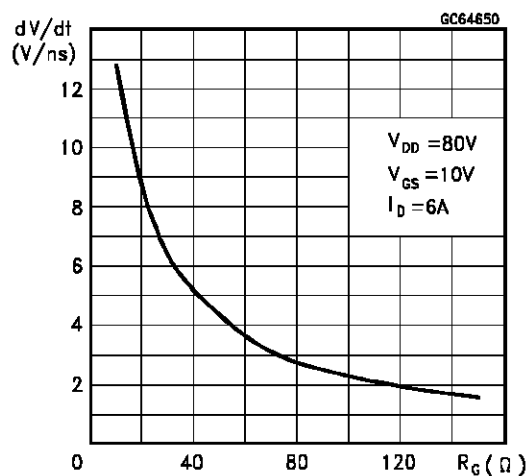
## Normalized On Resistance vs Temperature



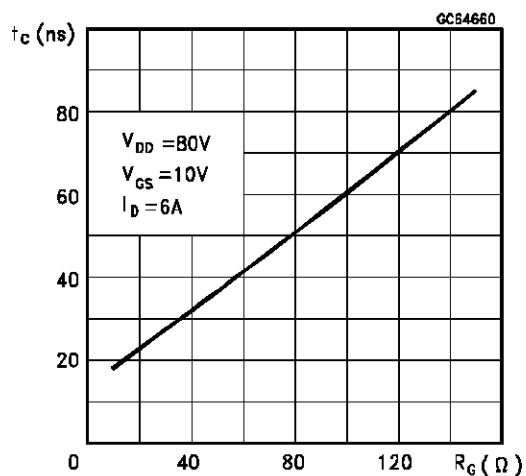
## Turn-on Current Slope



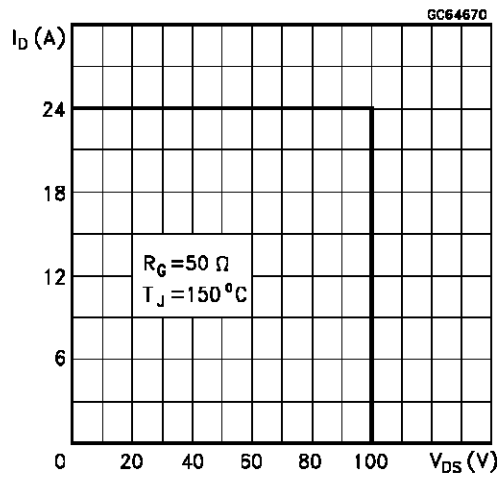
## Turn-off Drain-source Voltage Slope



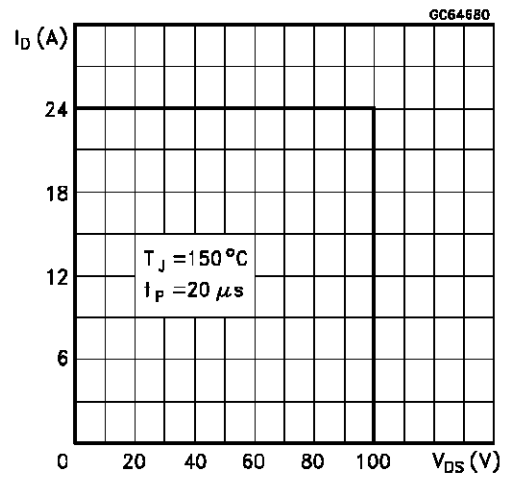
## Cross-over Time



Switching Safe Operating Area



Accidental Overload Area



Source-drain Diode Forward Characteristics

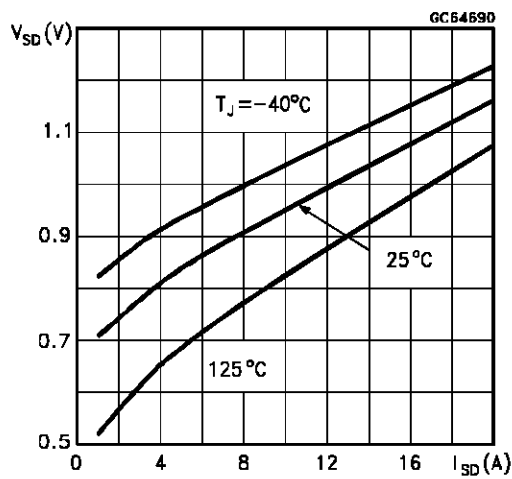
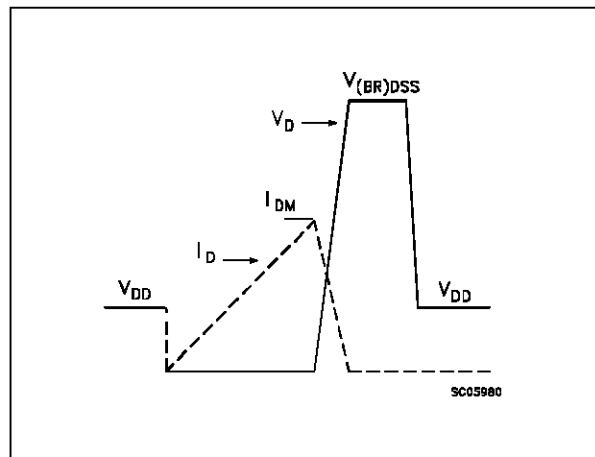
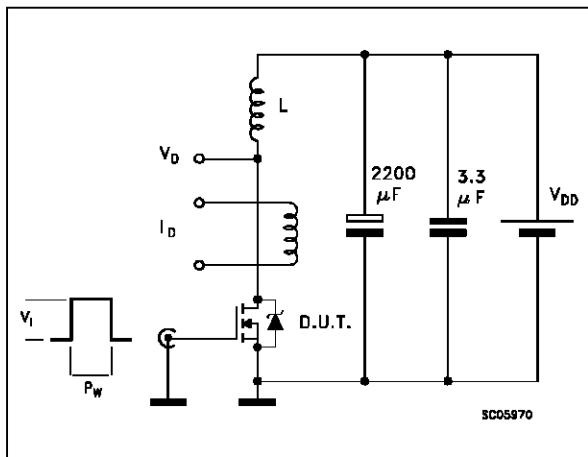
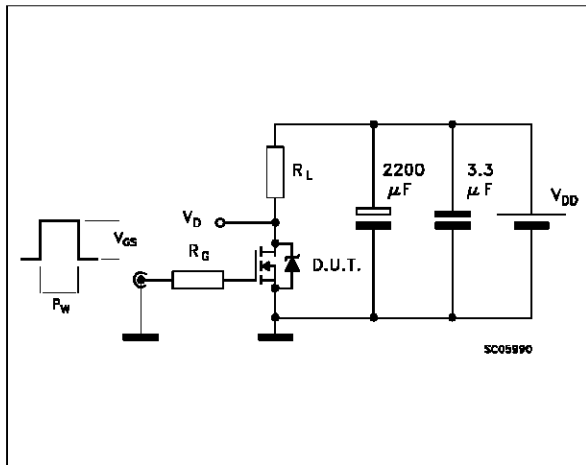
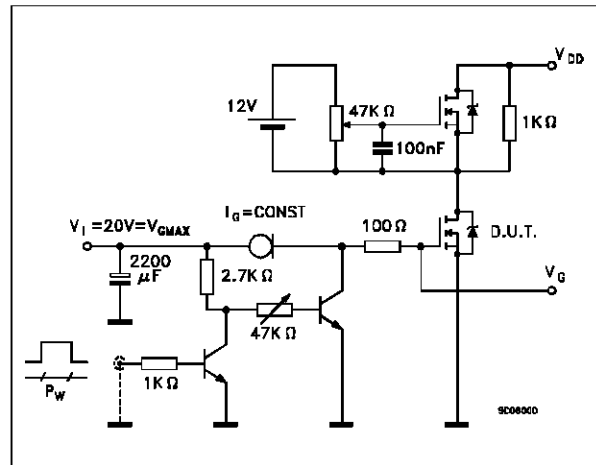
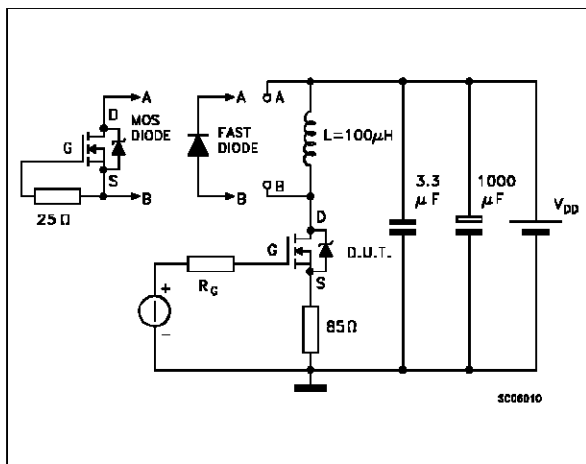


Fig. 1: Unclamped Inductive Load Test Circuits

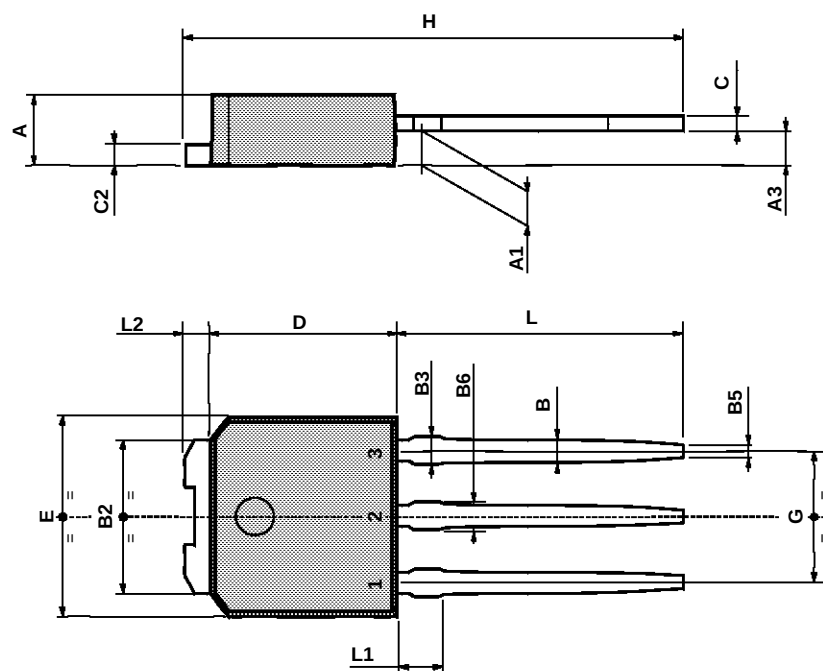
Fig. 2: Unclamped Inductive Waveforms



**Fig. 3:** Switching Times Test Circuits For Resistive Load**Fig. 4:** Gate Charge Test Circuit**Fig. 5:** Test Circuit For Inductive Load Switching And Diode Recovery Times

## TO-251 (IPAK) MECHANICAL DATA

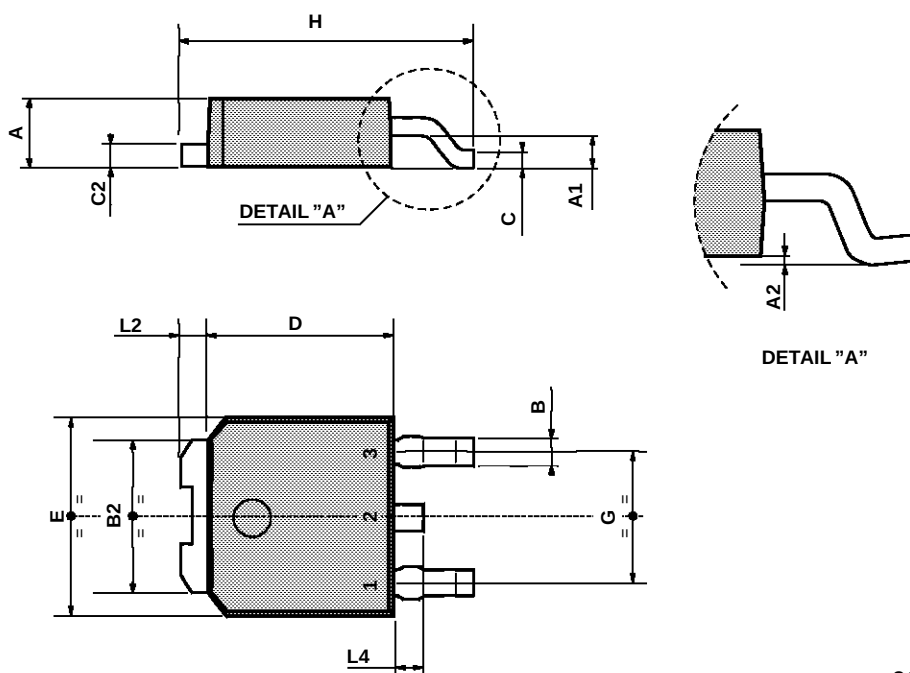
| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 2.2  |      | 2.4  | 0.086 |       | 0.094 |
| A1   | 0.9  |      | 1.1  | 0.035 |       | 0.043 |
| A3   | 0.7  |      | 1.3  | 0.027 |       | 0.051 |
| B    | 0.64 |      | 0.9  | 0.025 |       | 0.031 |
| B2   | 5.2  |      | 5.4  | 0.204 |       | 0.212 |
| B3   |      |      | 0.85 |       |       | 0.033 |
| B5   |      | 0.3  |      |       | 0.012 |       |
| B6   |      |      | 0.95 |       |       | 0.037 |
| C    | 0.45 |      | 0.6  | 0.017 |       | 0.023 |
| C2   | 0.48 |      | 0.6  | 0.019 |       | 0.023 |
| D    | 6    |      | 6.2  | 0.236 |       | 0.244 |
| E    | 6.4  |      | 6.6  | 0.252 |       | 0.260 |
| G    | 4.4  |      | 4.6  | 0.173 |       | 0.181 |
| H    | 15.9 |      | 16.3 | 0.626 |       | 0.641 |
| L    | 9    |      | 9.4  | 0.354 |       | 0.370 |
| L1   | 0.8  |      | 1.2  | 0.031 |       | 0.047 |
| L2   |      | 0.8  | 1    |       | 0.031 | 0.039 |



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## TO-252 (DPAK) MECHANICAL DATA

| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 2.2  |      | 2.4  | 0.086 |       | 0.094 |
| A1   | 0.9  |      | 1.1  | 0.035 |       | 0.043 |
| A2   | 0.03 |      | 0.23 | 0.001 |       | 0.009 |
| B    | 0.64 |      | 0.9  | 0.025 |       | 0.035 |
| B2   | 5.2  |      | 5.4  | 0.204 |       | 0.212 |
| C    | 0.45 |      | 0.6  | 0.017 |       | 0.023 |
| C2   | 0.48 |      | 0.6  | 0.019 |       | 0.023 |
| D    | 6    |      | 6.2  | 0.236 |       | 0.244 |
| E    | 6.4  |      | 6.6  | 0.252 |       | 0.260 |
| G    | 4.4  |      | 4.6  | 0.173 |       | 0.181 |
| H    | 9.35 |      | 10.1 | 0.368 |       | 0.397 |
| L2   |      | 0.8  |      |       | 0.031 |       |
| L4   | 0.6  |      | 1    | 0.023 |       | 0.039 |



0068772-B

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